

## CLAIMS

I claim:

1. A coated particle comprising

a. An interior core comprising a matrix consisting essentially of

i. at least one nanostructured liquid phase or a dehydrated variant thereof,

ii. at least one nanostructured liquid crystalline phase or a dehydrated variant thereof or

iii. a combination of

(1) at least one nanostructured liquid phase or a dehydrated variant thereof and

(2) at least one nanostructured liquid crystalline phase or a dehydrated variant thereof and

b. An exterior coating comprising nonlamellar domains.

2. The coated particle of claim 1, wherein said nanostructured liquid phase material comprises

a. a nanostructured L1 phase material,

b. a nanostructured L2 phase material,

c. a microemulsion that is nanostructured, or

d. a nanostructured L3 phase material.

3. The coated particle of claim 1, wherein said nanostructured liquid phase material comprises

a. a nanostructured normal or reversed cubic phase material,

b. a nanostructured normal or reversed hexagonal phase material,

c. a nanostructured normal or reversed intermediate phase material, or

d. a nanostructured lamellar phase material.

1 4. The coated particle of claim 1, wherein said nanostructured liquid phase material  
2 comprises

- 3 a. a polar solvent and  
4 b. a surfactant or a lipid.

1 5. The coated particle of claim 1, wherein said nanostructured liquid phase material  
2 comprises

- 3 a. a polar solvent,  
4 b. a surfactant or a lipid and  
5 c. an amphiphile or hydrophobe.

1 6. The coated particle of claim 1, wherein said nanostructured liquid phase material  
2 comprises

- 3 a. a block copolymer.

1 7. The coated particle of claim 1, wherein said nanostructured liquid phase material  
2 comprises

- 3 a. a block copolymer and  
4 b. a solvent.

1 8. The coated particle of claim 1, wherein said nanostructured liquid phase material  
2 comprises

- 3 a. a polar solvent and  
4 b. a surfactant.

1 9. The coated particle of claim 1, wherein said nanostructured liquid phase material  
2 comprises

- 3 a. a polar solvent,  
4 b. a surfactant and  
5 c. an amphiphile or hydrophobe.

- 1 10. The coated particle of claim 1, wherein said nanostructured liquid phase material  
2 comprises  
3 a. a block copolymer.
- 1 11. The coated particle of claim 1, wherein said nanostructured liquid phase material  
2 comprises  
3 a. a block copolymer and  
4 b. a solvent.
- 1 12. The coated particle of claim 1, wherein said interior core comprises an active agent  
2 disposed within said matrix.
- 1 13. The coated particle of claim 12, wherein said an active agent comprises paclitaxel.
- 1 14. The coated particle of claim 12, wherein said an active agent comprises capsaicin.
- 1 15. The coated particle of claim 12, wherein said an active agent comprises a photodynamic  
2 therapeutic agent.
- 1 16. The coated particle of claim 12, wherein said an active agent comprises an imaging agent.
- 1 17. The coated particle of claim 12, wherein said an active agent comprises a receptor protein.
- 1 18. The coated particle of claim 1, wherein said interior core comprises a reversed cubic  
2 phase material.
- 1 19. The coated particle of claim 18, wherein said interior core comprises an active agent  
2 disposed within said matrix.
- 1 20. The coated particle of claim 19, wherein said active agent comprises paclitaxel.

- 1     21. The coated particle of claim 19, wherein said active agent comprises capsaicin.
- 1     22. The coated particle of claim 19, wherein said active agent comprises a photodynamic  
2     therapeutic agent.
- 1     23. The coated particle of claim 19, wherein said active agent comprises a nucleic acid.
- 1     24. The coated particle of claim 19, wherein said active agent comprises a glycolipid.
- 1     25. The coated particle of claim 19, wherein said active agent comprises an amino acid.
- 1     26. The coated particle of claim 19, wherein said active agent comprises a polypeptide.
- 1     27. The coated particle of claim 19, wherein said active agent comprises a protein.
- 1     28. The coated particle of claim 19, wherein said active agent comprises an antineoplastic  
2     therapeutic agent.
- 1     29. The coated particle of claim 19, wherein said active agent comprises an antihypertensive  
2     agent.
- 1     30. The coated particle of claim 19, wherein said active agent comprises a rodent deterrent  
2     agent.
- 1     31. The coated particle of claim 19, wherein said active agent comprises a pheromone.
- 1     32. The coated particle of claim 19, wherein said active agent comprises a receptor protein.
- 1     33. A coated particle as defined by claim 1, wherein said matrix comprises a material having  
2     the physicochemical properties of a biomembrane.

- 1 34. A coated particle as defined by claim 33, wherein said biomembrane material comprises a  
2 biologically active polypeptide material.
- 1 35. A coated particle as defined by claim 33, wherein said matrix comprises a polypeptide or  
2 a protein immobilized in said biomembrane material.
- 1 36. The coated particle of claim 1 wherein said nonlamellar domain is amorphous.
- 1 37. The coated particle of claim 1 wherein said nonlamellar domain is a polymer.
- 1 38. The coated particle of claim 37 wherein said polymer is PLGA.
- 1 39. The coated particle of claim 36 wherein said nonlamellar domain comprises a sugar.
- 1 40. The coated particle of claim 39 wherein said sugar is trehalose.
- 1 41. The coated particle of claim 1 wherein said exterior coating comprises a semi-crystalline  
2 nonlamellar material.
- 1 42. The coated particle of claim 1 wherein said exterior coating comprises an imaging agent.
- 1 43. The coated particle of claim 1 wherein said exterior coating comprises a protein.
- 1 44. The coated particle of claim 1 wherein said exterior coating comprises at least 2%  
2 nonlamellar domains.
- 1 45. The coated particle of claim 1 wherein said exterior coating comprises at least 10%  
2 nonlamellar domains.
- 1 46. The coated particle of claim 1 wherein said exterior coating comprises at least 50%  
2 nonlamellar domains.

1 47. The coated particle of claim 1 wherein said exterior coating comprises a pharmaceutical  
2 active.

1 48. A coated particle comprising

- 2 a. An interior core comprising a matrix consisting essentially of
  - 3 i. at least one nanostructured liquid phase,
  - 4 ii. at least one nanostructured liquid crystalline phase or
  - 5 iii. a combination of
    - 6 (1) at least one nanostructured liquid phase and
    - 7 (2) at least one nanostructured liquid crystalline phase and
- 8 b. An exterior coating comprising nonlamellar domains.

1 49. A coated particle comprising

- 2 a. An interior core comprising a matrix consisting essentially of
  - 3 i. at least one nanostructured liquid phase,
  - 4 ii. at least one nanostructured liquid crystalline phase or
  - 5 iii. a combination of
    - 6 (1) at least one nanostructured liquid phase and
    - 7 (2) at least one nanostructured liquid crystalline phase and
- 8 b. An exterior coating comprising a nonlamellar material.

1 50. A method of making a coated particle comprising

- 2 a. An interior core comprising a matrix consisting essentially of
  - 3 i. at least one nanostructured liquid phase,
  - 4 ii. at least on nanostructured liquid crystalline phase or
  - 5 iii. a combination of
    - 6 (1) at least one nanostructured liquid phase and
    - 7 (2) at least one nanostructured liquid crystalline phase and
- 8 b. An exterior coating comprising a nonlamellar material

9 comprising

10 providing a volume of said matrix that includes at least on chemical species having a

11 moiety capable of forming a nonlamellar material upon reaction with a second moiety and  
12 contacting said volume with a fluid containing at least one chemical species having  
13 said second moiety to react said first moiety with said second moiety and contemporaneously  
14 subdividing said volume into particles by the application of energy to said volume.

1 51. A method of making a coated particle comprising

2 a. An interior core comprising a matrix consisting essentially of

3 i. at least one nanostructured liquid phase,

4 ii. at least on nanostructured liquid crystalline phase or

5 iii. a combination of

6 (1) at least one nanostructured liquid phase and

7 (2) at least one nanostructured liquid crystalline phase and

8 b. An exterior coating comprising a nonlamellar material

9 comprising

10 providing a volume of said matrix that includes said nonlamellar material dissolved  
11 therein and

12 causing said nonlamellar material to become insoluble in said matrix and  
13 contemporaneously subdividing said volume into particles by the application of energy to said  
14 volume.

1 52. A method of making a coated particle comprising

2 a. An interior core comprising a matrix consisting essentially of

3 i. at least one nanostructured liquid phase,

4 ii. at least on nanostructured liquid crystalline phase or

5 iii. a combination of

6 (1) at least one nanostructured liquid phase and

7 (2) at least one nanostructured liquid crystalline phase and

8 b. An exterior coating comprising a nonlamellar material

9 comprising

10 providing a volume of said matrix that includes said nonlamellar material dissolved  
11 therein and that includes at least one chemical species having a moiety capable of forming

12 said nonlamellar material upon reaction with a second moiety and  
13 contacting said volume with a fluid containing at least one chemical species having  
14 said second moiety to react said first moiety with said second moiety and contemporaneously  
15 causing said nonlamellar material to become insoluble in said matrix and subdividing said  
16 volume into particles by the application of energy to said volume.

1 53. A method of making a coated particle comprising

2 a. An interior core comprising a matrix consisting essentially of

- 3 i. at least one nanostructured liquid phase,  
4 ii. at least on nanostructured liquid crystalline phase or  
5 iii. a combination of

6 (1) at least one nanostructured liquid phase and

7 (2) at least one nanostructured liquid crystalline phase and

8 b. An exterior coating comprising a first nonlamellar material and a second  
9 nonlamellar material

10 comprising

11 providing a volume of said matrix that includes said first nonlamellar material  
12 dissolved therein and that includes at least one chemical species having a moiety capable of  
13 forming said second nonlamellar material upon reaction with a second moiety and  
14 contacting said volume with a fluid containing at least one chemical species having  
15 said second moiety to react said first moiety with said second moiety and contemporaneously  
16 causing said first nonlamellar material to become insoluble in said matrix and subdividing  
17 said volume into particles by the application of energy to said volume.

1 54. A method of making a coated particle comprising

2 a. An interior core comprising a matrix consisting essentially of

- 3 i. at least one nanostructured liquid phase,  
4 ii. at least one nanostructured liquid crystalline phase or  
5 iii. a combination of

6 (1) at least one nanostructured liquid phase and

7 (2) at least one nanostructured liquid crystalline phase and



8           b.     An exterior coating comprising a nonlamellar material  
9 comprising  
10           dispersing a volume of said matrix in a form of said nonlamellar material selected  
11 from the group consisting of liquefied form, solution, or fluid precursor, and  
12           solidifying said nonlamellar material by a techniques selected from the group  
13 consisting of cooling, evaporating a volatile solvent, or implementing a chemical reaction.

1   55. A method of making a coated particle comprising

2   a.     An interior core comprising a matrix consisting essentially of

- 3           i.     at least one nanostructured liquid phase,
- 4           ii.    at least one nanostructured liquid crystalline phase or
- 5           iii.   a combination of
- 6                       (1) at least one nanostructured liquid phase and
- 7                       (2) at least one nanostructured liquid crystalline phase and

8           b.     An exterior coating comprising a nonlamellar material  
9 comprising  
10           dispersing particles of said matrix into a fluid that includes at least one chemical  
11 species having a moiety capable of forming a nonlamellar material upon reaction or  
12 association with a second moiety and  
13           adding to said dispersion at least one chemical species having said second moiety to  
14 react said first moiety with said second moiety.

1   56. A method as in Claim 55 wherein said chemical species having said first moiety is  
2 preferentially associated with the particles of said matrix at the time the chemical species  
3 having said second moiety is added.

1   57. A method of making a coated particle comprising

2   a.     An interior core comprising a matrix consisting essentially of

- 3           i.     at least one nanostructured liquid phase,
- 4           ii.    at least one nanostructured liquid crystalline phase or
- 5           iii.   a combination of

(1) at least one nanostructured liquid phase and  
(2) at least one nanostructured liquid crystalline phase and  
b. An exterior coating comprising a nonlamellar material  
comprising  
dispersing particles of said matrix into a fluid that includes at least one chemical  
species having a moiety capable of forming a nonlamellar material upon reaction or  
association with a second moiety and  
adding to said dispersion at least one chemical species having said second moiety to  
react said first moiety with said second moiety and  
subdividing the resulting material into particles by the application of energy to said  
material.

58. A method as in Claim 57 wherein said chemical species having said first moiety is  
preferentially associated with the particles of said matrix at the time the chemical species  
having said second moiety is added.

59. A method of making a coated particle comprising

a. An interior core comprising a matrix consisting essentially of  
i. at least one nanostructured liquid phase,  
ii. at least one nanostructured liquid crystalline phase or  
iii. a combination of  
(1) at least one nanostructured liquid phase and  
(2) at least one nanostructured liquid crystalline phase and  
b. An exterior coating comprising a nonlamellar material  
comprising  
dispersing or dissolving a volume of said matrix in a liquid comprising said  
nonlamellar material in solution or dispersed form and comprising also a volatile solvent, and  
spray-drying said solution or dispersion.

60. A method of using a coated particle comprising

a. An interior core comprising a matrix consisting essentially of

- i. at least one nanostructured liquid phase,
- ii. at least on nanostructured liquid crystalline phase or
- iii. a combination of
  - (1) at least one nanostructured liquid phase and
  - (2) at least one nanostructured liquid crystalline phase and

b. An exterior coating comprising a nonlamellar material comprising disposing said particle in a fluid medium comprising an adsorbable material and adsorbing said adsorbable material on said exterior coating.

61. A method of using a coated particle comprising

- a. An interior core comprising a matrix consisting essentially of
  - i. at least one nanostructured liquid phase,
  - ii. at least on nanostructured liquid crystalline phase or
  - iii. a combination of
    - (1) at least one nanostructured liquid phase and
    - (2) at least one nanostructured liquid crystalline phase and

b. An exterior coating comprising a nonlamellar material comprising disposing said particle in a fluid medium comprising an absorbable material and absorbing said absorbable material in said interior core.

62. The method of claim 61 wherein said absorbing is triggered by dissolution of said exterior coating by said fluid medium.

63. The method of claim 61 wherein said absorbing is triggered by disruption of said exterior coating.

64. The method of claim 61 wherein said absorbing occurs through pores in said exterior coating.

1 65. A method of using a coated particle comprising

2 a. An interior core comprising a matrix consisting essentially of

3 i. at least one nanostructured liquid phase,

4 ii. at least on nanostructured liquid crystalline phase or

5 iii. a combination of

6 (1) at least one nanostructured liquid phase and

7 (2) at least one nanostructured liquid crystalline phase and

8 b. An exterior coating comprising a nonlamellar material

9 comprising

10 disposing said particle in a fluid medium comprising an absorbable material and

11 absorbing said absorbable material in said exterior coating.

1 66. A method of using a coated particle comprising

2 a. An interior core comprising a matrix consisting essentially of

3 i. at least one nanostructured liquid phase,

4 ii. at least on nanostructured liquid crystalline phase or

5 iii. a combination of

6 (1) at least one nanostructured liquid phase and

7 (2) at least one nanostructured liquid crystalline phase and

8 b. An exterior coating comprising a nonlamellar material

9 comprising

10 disposing said particle in a fluid medium comprising an absorbable material and

11 absorbing said absorbable material in said interior core and exterior coating.

1 67. A method of using a coated particle comprising

2 a. An interior core comprising a matrix consisting essentially of

3 i. at least one nanostructured liquid phase,

4 ii at least on nanostructured liquid crystalline phase or

5 iii. a combination of

6 (1) at least one nanostructured liquid phase and

7 (2) at least one nanostructured liquid crystalline phase,

8 said matrix comprising an active agent disposed therein, and  
9 b. An exterior coating comprising a nonlamellar material  
10 comprising  
11 disposing said particle in a fluid medium and  
12 releasing said active agent into said fluid medium.

1 68. The method of claim 67, wherein said release is triggered by dissolution of said exterior  
2 coating by said fluid medium.

1 69. The method of claim 67, wherein said release is triggered by disruption of said exterior  
2 coating.

1 70. The method of claim 67, wherein said release is occurs through pores in said exterior  
2 coating.

1 71. A method of using a coated particle comprising  
2 a. An interior core comprising a matrix consisting essentially of  
3 i. at least one nanostructured liquid phase,  
4 ii. at least on nanostructured liquid crystalline phase or  
5 iii. a combination of  
6 (1) at least one nanostructured liquid phase and  
7 (2) at least one nanostructured liquid crystalline phase,  
8 said matrix comprising an active agent disposed therein, and  
9 b. An exterior coating comprising a nonlamellar material  
10 comprising  
11 releasing said active agent.

1 72. The method of claim 71, wherein said release is triggered by dissolution of said exterior  
2 coating.

1 73. The method of claim 71, wherein said release is triggered by disruption of said exterior  
2 coating.

1 74. The method of claim 71, wherein said release is occurs through pores in said exterior  
2 coating.

1 75. A coated particle comprising  
2 a. an interior core comprising a matrix consisting essentially of  
3 i. at least one nanostructured liquid phase,  
4 ii. at least one nanostructured liquid crystalline phase or  
5 iii. a combination of  
6 (1) at least one nanstructured liquid phase and  
7 (2) at least one nanostructured liquid crystalline phase and  
8 b. an exterior coating comprising nonlamellar domains, and  
9 c. a targeting moiety associated with said coated particle.

1 76. The coated particle of claim 75, wherein said nonlamellar domains comprise material  
2 selected from the group consisting of nonlamellar crystalline material, nonlamellar  
3 amorphous material, and nonlamellar semi-crystalline material.

1 77. The coated particle of claim 75 wherein said targeting moiety is selected from the group  
2 consisting of protein, nucleic acid, polysaccharide and magnetically responsive material.

1 78. The coated particle of claim 75 wherein said targeting moiety is associated with said  
2 exterior coating of said coated particle.

1 79. The coated particle of claim 78 wherein said targeting moiety is adsorbed to an inner  
2 surface of said exterior coating of said coated particle.

1 80. The coated particle of claim 78 wherein said targeting moiety is embedded in said  
2 exterior coating of said coated particle.

- 1 81. The coated particle of claim 78 wherein said targeting moiety is associated with an outer  
2 surface of said exterior coating of said coated particle.
- 1 82. The coated particle of claim 81 wherein said targeting moiety is associated with said outer  
2 surface of said exterior coating of said coated particle by a means selected from the group  
3 consisting of adsorption, covalent bonding, ionic bonding, hydrogen bonding, and  
4 hydrophobic interactions.
- 1 83. The coated particle of claim 75 wherein said targeting moiety is associated with the  
2 interior core of said coated particle.
- 1 84. The coated particle of claim 75 wherein said targeting moiety is associated with a phase  
2 present between said exterior coating and said interior core.
- 1 85. The coated particle of claim 75 wherein said targeting moiety is associated by a means  
2 selected from the group consisting of covalent bonding, ionic bonding, adsorption,  
3 absorption, hydrogen bonding, and hydrophobic interactions.
- 1 86. The coated particle of claim 75 wherein said targeting moiety is associated with said  
2 coated particle via a flexible spacer molecule.
- 1 87. The coated particle of claim 75 wherein said exterior coating comprises at least 2%  
2 nonlamellar domains.
- 1 88. The coated particle of claim 75 wherein said exterior coating comprises at least 10%  
2 nonlamellar domains.
- 1 89. The coated particle of claim 75 wherein said exterior coating comprises at least 50%  
2 nonlamellar domains.

- 1 90. A coated particle comprising  
2 a. an interior core comprising a matrix consisting essentially of  
3 i. at least one nanostructured liquid phase,  
4 ii. at least one nanostructured liquid crystalline phase or  
5 iii. a combination of  
6 (1) at least one nanostructured liquid phase and  
7 (2) at least one nanostructured liquid crystalline phase and  
8 b. an exterior coating comprising nonlamellar domains, and  
9 c. a bioactive agent associated with said coated particle.
- 1 91. The coated particle of claim 90, wherein said nonlamellar domains comprise material  
2 selected from the group consisting of nonlamellar crystalline material, nonlamellar  
3 amorphous material, and nonlamellar semi-crystalline material.
- 1 92. The coated particle of claim 90 wherein said bioactive agent is selected from the group  
2 consisting of adsorption enhancers, adsorption-modulating materials, vaccine adjuvants,  
3 antibodies, steroids, hormones, oligosaccharides, polysaccharides, modulators of protein  
4 binding activity, lectins, receptors, nucleic acids, proteins.
- 1 93. The coated particle of claim 90 wherein said bioactive agent is associated with said  
2 exterior coating of said coated particle.
- 1 94. The coated particle of claim 90 wherein said bioactive agent is adsorbed to an inner  
2 surface of said exterior coating of said coated particle.
- 1 95. The coated particle of claim 90 wherein said bioactive agent is embedded in said exterior  
2 coating of said coated particle.
- 1 96. The coated particle of claim 90 wherein said bioactive agent is associated with an outer  
2 surface of said exterior coating of said coated particle.



1 97. The coated particle of claim 90 wherein said bioactive agent is associated with said outer  
2 surface of said exterior coating of said coated particle by a means selected from the group  
3 consisting of adsorption, covalent bonding, ionic bonding, hydrogen bonding, and  
4 hydrophobic interactions.

1 98. The coated particle of claim 90 wherein said bioactive agent is associated with the  
2 interior core of said coated particle.

1 99. The coated particle of claim 90 wherein said bioactive agent is associated with a phase  
2 present between said exterior coating and said interior core.

1 100. The coated particle of claim 90 wherein said bioactive agent is associated by a means  
2 selected from the group consisting of covalent bonding, ionic bonding, adsorption,  
3 absorption, hydrogen bonding, and hydrophobic interactions.

1 101. The coated particle of claim 90 wherein said bioactive agent is associated with said  
2 coated particle via a flexible spacer molecule.

1 102. The coated particle of claim 90 wherein said exterior coating comprises at least 2%  
2 nonlamellar domains.

1 103. The coated particle of claim 90 wherein said exterior coating comprises at least 10%  
2 nonlamellar domains.

1 104. The coated particle of claim 90 wherein said exterior coating comprises at least 50%  
2 nonlamellar domains.

1 105. A coated particle comprising  
2 a. An interior core comprising a matrix consisting essentially of  
3 i. at least one polymerized nanostructured liquid phase or a dehydrated variant  
4 thereof,

- 5                   ii. at least one polymerized nanostructured liquid crystalline phase or a  
6                   dehydrated variant thereof or  
7                   iii. a combination of  
8                   (1) at least one polymerized nanostructured liquid phase or a  
9                   dehydrated variant thereof and  
10                  (2) at least one polymerized nanostructured liquid crystalline phase or a  
11                  dehydrated variant thereof and  
12                  b. An exterior coating comprising nonlamellar domains.

1       106. The coated particle of claim 105, wherein said polymerized nanostructured liquid phase  
2       material comprises

- 3                  a. a polymerized nanostructured normal or reversed cubic phase material,  
4                  b. a polymerized nanostructured normal or reversed hexagonal phase material,  
5                  c. a polymerized nanostructured normal or reversed intermediate phase material, or  
6                  d. a polymerized nanostructured lamellar phase material.

1       107. The coated particle of claim 105, wherein said polymerized nanostructured liquid phase  
2       material comprises

- 3                  a. a polymerized nanostructured normal or reversed cubic phase material, or  
4                  b. a polymerized nanostructured normal or reversed hexagonal phase material.